

ORIGINAL ARTICLE

Ultrasound-using breast cancer detection trial in the community of Central Vietnam: initial results and proposal

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ABSTRACT

BACKGROUND: Breast cancer is the most common malignancy among Vietnamese women. While breast ultrasound is widely accessible, mammography remains unavailable in many areas in Vietnam. There is a limited amount of data about breast cancer detection by ultrasound in the community of the country. This study aimed to evaluate the utility of ultrasound as a primary modality for early breast cancer detection at local health centers.

METHODS: We recruited women from the age of 30 and above in the community into this descriptive cross-sectional study. In collaboration with the local Vietnam Women's Union and health centers, participants completed questionnaires and underwent free breast ultrasound examinations conducted by experienced radiologists. Breast lesions were categorized using the ACR BI-RADS. Women with suspicious findings were recalled to Hue University of Medicine and Pharmacy Hospital for further diagnostic evaluation.

RESULTS: Among 6073 participating women, the mean age was 47.3±9.9 years (range: 30-84). Suspicious lesions (Breast Imaging-Reporting and Data System 4-5) were detected in 102 women (1.7%), with five cases confirmed as malignant, resulting in a cancer detection rate (CDR) of 0.82 per 1000 women. Additionally, 58% of participants reported sedentary behavior as a modifiable risk factor.

CONCLUSIONS: This study underscores the feasibility of using ultrasound for early breast cancer detection in community settings. The recall rate, CDR and high prevalence of sedentary behavior suggest the need for a community-based approach to improve breast CDR in Central Vietnam.

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KEY WORDS: Breast neoplasms; Ultrasonography; Early diagnosis; Risk factors.

Globally, breast cancer is recognized as the most commonly diagnosed malignancy and a leading contributor to cancer-related deaths among women.¹ In Vietnam, data from the International Agency for Research on Cancer estimated 24,563 new cases of breast cancer and 10,008 related deaths in 2022. This positions breast cancer as the most prevalent form of cancer and the fourth highest cause of cancer-related mortality among Vietnamese women.² Although these rankings have stayed consistent, the numbers of new cases and deaths have shown an upward trend over time, increasing from 21,555 cases and 9345 deaths in 2020.³ Notably, breast cancer tends to occur at younger ages in Vietnamese women compared to their Western counterparts.⁴⁻⁶ Diagnostic and treatment delays are common in Vietnam, a low- to middle-income country, further exacerbating the problem.⁷ Breast cancer in younger women is often more aggressive and detected at later stages,^{8, 9} leading to reduced treatment efficacy, higher costs, and poorer survival outcomes.^{10, 11} Consequently, early detection is critical to reducing the disease burden, minimizing financial strain on patients and the healthcare system, and improving survival rates in Vietnam. Several screening methods, including clinical breast examinations, self-examinations, mammography, ultrasound, and magnetic resonance imaging (MRI), are employed in developed countries. Among these, mammography is the most evidence-based approach for reducing mortality.^{12, 13} However, its application in Vietnam is limited due to an insufficient number of machines, a shortage of skilled radiologists, and a concentration of resources in urban hospitals. Additionally, mammography is more expensive than ultrasound.¹⁴ In contrast, breast ultrasound is widely available in Vietnam. It is a cost-effective, painless, radiation-free procedure that can be repeated as needed. Ultrasound is particularly effective in detecting cancers missed by mammography, especially in Asian women with dense breast tissue.^{13, 15} Currently, Vietnam lacks a nationwide breast cancer screening program,¹⁶ and data on early detection initiatives, such as free ultrasound screenings in Central Vietnam and beyond, remain scarce. This research seeks to assess the utility of breast ultra-

sound as a modality for early detection of breast cancer within the community.

Materials and methods

This study has been approved by the Council for Ethics in Biomedical Research of Hue University of Medicine and Pharmacy, Hue University. Professor Vo Tam, the chairman of the Council, signed the approval H2020/164 on June 5, 2020. The study was conducted in accordance with the principles of the Helsinki Declaration. Oral informed consent of the study participants was obtained when the study was being conducted. The authors have protected the personal information of the study participants from being publicized.

Sample

This descriptive cross-sectional study recruited women in the community in many communes and wards in Central Vietnam. We used the method of Buderer to calculate the minimum sample size (Equation 1, 2):

$$n_{\text{Sensitivity}} = \frac{TP + FN}{p}; \quad (1)$$

$$TP + FN = Z^2 \times \frac{\text{Sensitivity} \times (1 - \text{Sensitivity})}{W^2}$$

$$n_{\text{Specificity}} = \frac{TN + FP}{1 - p}; \quad (2)$$

$$TN + FP = Z^2 \times \frac{\text{Specificity} \times (1 - \text{Specificity})}{W^2}$$

where N. is the required sample size, P is the prevalence of breast cancer, Z is the normal distribution value is set to 1.96 as corresponding with 95% confidence interval (CI), and W is the the maximum acceptable width of the 95% CI and set to 10%. We used the results from the study of Ho *et al.*¹⁴ as a reference, in which the proportion of breast cancer detected by ultrasound was 1.37%, the sensitivity and specificity of ultrasound was 81.82 and 95.45%, respectively.¹⁴ Therefore, the calculated minimum sample size for our study was 4219.

A multistage stratified sampling method was utilized to recruit females who were 30 years old and older into the study. In the first stage,

we chose Thua Thien Hue and Quang Binh Province among the central provinces of Vietnam. We randomly picked out three cities/districts/towns of each province; then the next step was choosing three communes/wards from each subprovincial region. We collaborated with local Vietnam Women's Union staff and health centers' personnel to invite women aged 30 and above to participate in the study based on their statistical lists. The exclusion criteria covered women with breast lesions previously diagnosed as cancer, women with breast implants, breast-feeding, and pregnant women.

Study equipment

We designed a survey form consisting of questions about sociodemography, medical history, reproductive health, some lifestyle-related breast cancer risk factors, and spaces for briefly reporting findings of breast ultrasound examinations. We also created an ultrasound report form to give to the participants after finishing the ultrasound procedures.

To perform ultrasound examinations, we utilized high-frequency linear transducers of portable ultrasound machines from the brands Mindray Z5 and Clarius.

Process

Our team built a standard protocol for breast ultrasound, in which breasts and axillae were scanned on both sides. All the radiologist members were well-trained in that protocol before taking trips to the community.

From 2020 to 2023, we organized examination episodes at the local health centers of the chosen communes or wards. We had some interrupted periods due to the COVID-19 pandemic.

In each episode at the local health centers, our collaborators conducted interviews with the designed questionnaire and radiologists performed free ultrasound exams for invited women. The radiologists used Breast Imaging-Reporting and Data System (BI-RADS) classification of the American College of Radiology 2013 to review the ultrasound images while performing the procedures. The findings were noted in the survey forms for the archive and in ultrasound report

forms to hand out to the attending females. Besides, the participants were trained to perform breast self-examinations through instruction from medical staff and related brochures.

The women with results of BI-RADS 1, 2, and 3 were categorized as non-suspicious groups, suggested to follow up according to ACR management instruction and to do well with breast self-examination monthly at home. The ones with BI-RADS 4 and 5 breast lesions were categorized in suspicious group and strongly recommended for further work-up at Hue University of Medicine and Pharmacy Hospital. Those who came to the hospital would receive rechecking ultrasound examinations and/or mammography, and/or MRI and fine needle aspiration (FNA) or core biopsy procedures in the case.

Statistical analysis

We utilized Microsoft Excel (Microsoft Corp., Redmond, WA, USA) as a tool to input data. Then, the SPSS software program for Windows, version 20.0 (SPSS Inc., Chicago, IL, USA), was used to analyze the data with descriptive statistics. The variables include the frequencies of age groups, risk factors, ultrasound results, pathology results of participants, the recall rate, and cancer detection rate (CDR). The ratio between the number of women with BI-RADS 4-5 lesions and the total number of participants is the recall rate. The CDR is the ratio between the number of detected breast cancer cases and the total number.

Results

In the study's period, 6073 women meeting the criteria of the study underwent breast ultrasound in the community with the aim to early detect breast cancer. The main initial results are present in Table I, II, III, IV.

Characteristics of participants

Among 6073 women meeting the study's criteria, the oldest women were 84 years old, and the youngest were 30 as the minimum age threshold of inclusion criteria. The mean age was 47.3 ± 9.9 . The high-risk age group (from 50 years old and above) accounted for 41%.

The most common risks from lifestyle are being sedentary (58%) and passive cigarette smoke inhaler (36.3%). At the same time, other features accounted for the minority.

TABLE I.—*Distribution of age (N.=6073).*

Age group	30-39	40-49	50-59	≥60	Total
Frequency	1528	2052	1752	741	6073
Percentage (%)	25.2	33.8	28.8	12.2	100

TABLE II.—*Risk factors of participants (N.=6073).*

Risk factors	Frequency	Percentage (%)
Positive family history of breast cancer	139	2.3
History of breast cancer	32	0.5
History of radiation exposure before age of 30	128	2.1
History of detecting breast lesions	755	12.4
Single	109	1.8
Late age at the first giving birth (older than 35)	191	3.1
Short time of breast feeding (less than 1 year)	629	10.4
Early age of menarche (younger than 12)	260	4.3
Late age of menopause (older than 55)	189	3.1
Postmenopausal hormone therapy	184	3.0
Frequent hormonal contraceptive methods	699	11.5
Frequent alcohol drinking	76	1.3
Frequent smoking	152	2.5
Passive smoke	2205	36.3
Sedentary (<4 h physical activities/week)	3525	58.0

The most common risks from lifestyle are being sedentary (58%) and passive cigarette smoke inhaler (36.3%). At the same time, other features accounted for the minority.

TABLE III.—*BI-RADS distribution of participants (N.=6073).*

BI-RADS category	Frequency	Percentage (%)
BI-RADS 1	4513	74.3
BI-RADS 2	930	15.3
BI-RADS 3	528	8.7
BI-RADS 4	98	1.6
BI-RADS 5	4	0.1

BI-RADS: Breast Imaging-Reporting and Data System.

TABLE IV.—*Pathology distribution by age (N.=40).*

Age group	Benign	Malignant
30-39	5	0
40-49	21	1
50-59	4	4
≥60	5	0
Total	35	5

Ultrasound results and breast cancer outcomes

About three-quarters of participants had normal breast ultrasound results. There were 102 women with suspicious breast lesions (BI-RADS 4 and 5), accounting for 1.7% of the total. Among them, 64 women (62.7%) had sedentary behavior and 35 women (34.3%) were frequently exposed to passive smoke.

Among those 102 participants, 65 women came to hospitals and clinics (including Hue University of Medicine and Pharmacy) to work up, and 40 women underwent FNA or biopsy procedures. Five females were diagnosed with breast malignancy. Their ages were 42, 51, 53, 55, and 56 at the time of detection. The pathological results of 5 lesions were invasive adenocarcinoma. There were 4 patients diagnosed with stage II and one with stage III breast cancer.

Discussion

From our perspective, the most notable results of this project are the recall rate, the CDR and the high prevalence of modifiable risk factor as sedentary.

In our study, 102 women had the ultrasound results with BI-RADS 4 and 5 breast lesions, so the recall rate was 1.7%. Meanwhile, in Vietnam, Ho *et al.*¹⁴ conducted a study to compare values of ultrasound and mammography in breast screening at Ho Chi Minh University Medical Center, and ultrasound detected 77 people with BI-RADS 4 and 5 lesions among 1319 women, which accounts for 5.85%.¹⁴ Considering international literature, a recent meta-analysis by Yang *et al.*¹⁵ showed the recall rate of ultrasound as a primary tool for breast screening was 5.9%.¹⁵ Therefore, our recall rate is lower than rates from the 2 above studies. This difference might be explained due to the different sampling methods and criteria of population recruited.¹⁷ In the study by Ho *et al.*,¹⁴ the participants from many areas of Southern Vietnam came to the hospital for breast screening exams and were 40 years old and above. The recall rate of only 1.7% in our study highlights a significant advantage in reducing unnecessary follow-up and easing the workload on healthcare facilities. In case of

well-organized primary care system, women can benefit a regular evaluation and proactive monitoring within their communities, this low recall rate ensures that only those with a suspect lesion require further diagnosis at specialized centers.

By streamlining the screening process and minimizing the number of women referred for advanced investigations, healthcare resources, such as diagnostic imaging services and specialist consultations, can be allocated more efficiently. This approach not only reduces the strain on hospitals but also improves patient experiences by minimizing the time, cost, and anxiety associated with additional testing. Women with lesion BI-RADS 1-2 and almost BI-RADS 3 encouraged to maintain routine evaluation in local health center and women with BI-RADS 4 and 5 are promptly identified and referred. In the long term, such a system could optimize healthcare delivery in low- to middle-income countries, where resources are limited and the demand for cancer screening is high.

Beyond geographic and transportation barriers, traditional beliefs, cultural norms, and ethical considerations often discourage women from seeking preventive care. Additionally, a lack of awareness about the importance of early detection exacerbates delays in seeking medical attention, particularly in asymptomatic cases. By overcoming these barriers, there is an opportunity to detect breast cancer at earlier stages, significantly reducing treatment costs and improving survival rates. Strengthening community outreach, subsidizing screening programs, and integrating culturally sensitive practices can encourage more women to participate in regular screenings. These efforts would not only alleviate the healthcare burden but also empower women to take proactive steps toward their health, fostering a shift toward early detection and timely intervention in low- to middle-income countries like Vietnam.

Among 6073 participants, we detected 5 breast cancers from 5 women, which means the CDR was 0.82/1000. Whereas, in the study by Ho *et al.*,¹⁴ of 1319 participants, 18 women were detected with breast cancer by ultrasound; the CDR was 13.65/1000.¹⁴ In another domestic study reported by Tran *et al.*, researchers col-

laborated with hospitals/clinics all around Vietnam and invited females who cared for or visited patients to join the screening program, then diagnosed 11 cases of cancer among 10,095 participants, and the CDR was 1.09/1000.¹⁸ In the study by Yang *et al.* presented that the CDR of primary ultrasound was 4.6/1000.¹⁵ One meta-analysis by Wang *et al.* showed that crude prevalences of breast cancer in an Asian population was from 2.6 to 5.7/1000.¹³ According to statistics of GLOBOCAN 2022, the age-standardized incidence of breast cancer in Southeast Asia was 0.42/1000.¹ When comparing our study to the above-listed literature, there is a relative similarity between our CDR and the rates from Tran's study and GLOBOCAN 2022. Our CDR is much lower than the rates from the study of the study by Ho *et al.*,¹⁴ and two meta-analyses. Different sampling methods and criteria might contribute to this scenario. One fact that affected the CDR is the small proportion of women who came to hospitals for further workup.

As the distribution in Table II, the sedentary behavior and passive smoke highlighting two common modifiable risk factors of this participants. Numerous studies published since 2013 have shown a strong correlation between higher levels of physical activity and a lower risk of developing breast cancer.^{19, 20} Kehm *et al.* found that engaging in regular physical activity could lower the risk of breast cancer by as much as 20% compared to those with a sedentary lifestyle.²¹ Importantly, breast cancer diagnosed in individuals under 40 years of age, classified as "young adults" is associated with a poorer prognosis compared to older women.¹⁹ Moreover, women who engage in active exercises from adolescents are less likely to develop breast cancer later in life compared to their less active counterparts.²²

Although sedentary behavior is not considered a direct risk factor for breast cancer, its modifiable nature emphasizes its potential for prevention. Promoting physical activity and encouraging lifestyle changes can play a pivotal role in reducing breast cancer incidence and mortality, particularly among young adults.²³ Recent studies on modifiable risk factors reinforce the critical need to leverage these opportunities to prevent breast cancer and advocate for popula-

tion-based prevention strategies to mitigate this growing public health challenge.²⁴

Breast cancer remains a significant public health challenge worldwide, particularly in low-resource settings where early detection and timely intervention are limited. In our community-based study, 6073 women participated, answered the questionnaire to identify risk factors and received breast ultrasound examinations. The findings revealed 102 cases classified as BI-RADS 4-5, who were recalled for diagnostic evaluation in specialized hospitals. Among the 65 participants who underwent in-depth diagnostic procedures, 5 cases of breast cancer were confirmed, reflecting CDR of 0.8/1000 in the community and 7.7% among hospital re-evaluations. These results can highlight the efficacy of implementing programs to detect breast cancer early at the primary health care level in reducing diagnostic delays, medical and transportation costs, and the burden on tertiary health centers.

Based on insights from these studies and preliminary findings from our pilot research, we emphasize the critical role of educating individuals about breast cancer risk factors, prevention opportunities, and the advantages of proactive health practices. Promoting regular breast self-examinations at home and routine ultrasound evaluations at primary healthcare centers represents a significant step toward reducing breast cancer mortality through early detection.^{17, 25, 26} As consequence, we propose a potential community-focused approach for early breast cancer detection in Vietnam, with three key components:

- routine ultrasound at local health center – ultrasound is effective for young women and those with dense breast tissue, where mammography has limitations; periodic screenings every 6-12 months, as shown in studies from Japan and South Korea, increase early detection rates;^{17, 27, 28} Our study supports this idea by identifying 102 BI-RADS 4-5 cases, with five cancers among 6073 women, which demonstrates the value of primary-level ultrasound in reducing diagnostic delays;
- breast self-examination – this method is a trainable, simple and cost-effective to detect early changes in their own breast; however, many

women lack proper awareness about the value of breast self-examination; local health centers' personnel can address this gap by providing educational workshops, instructional materials, and periodic follow-up to promote habit formation, improving early detection rates;^{25, 29}

- risk factors screening – using questionnaires to assess inherited and modifiable risk factor as family history, lifestyle and symptoms helps identify high-risk individuals; genetic testing for BRCA1/BRCA2 mutations and lifestyle assessments, as recommended by the NCCN, refine risk prediction and enable personalized prevention plans;^{21, 23, 26, 30-32} local health centers' staff and health coach play a crucial role in supporting these efforts, guiding women in proactive care, and bridging access to specialized services.

This integrated model might reduce overload for specialized hospitals, optimize resources of many levels especially health care cost and promote proactive care.^{25, 33, 34} By decentralizing screening and customized strategies to meet individual needs, it might be a scalable solution for improving breast cancer outcomes and public health.

Limitations of the study

This study presents some limitations that should be acknowledged. Firstly, as presented above, only 63.7% of women with suspicious breast lesions came to many hospitals and clinics for re-check and further exams, while we had expected all of them to come to our Hue University of Medicine and Pharmacy Hospital. Many factors might contribute to this fact, including long distances, difficulties in gaining access to transportation, time, work, and finance management. Besides, we lost contact with some participants. Consequently, we did not have enough data to analyze some performance values of ultrasound as a screening modality. Secondly, this is a cross-sectional descriptive study, so we could not follow-up on all the women with BI-RADS 3 breast lesions. Thirdly, the COVID-19 pandemic happened when the study was in progress, which produced some delays and difficulties for our team, collaborators, and women in the community. Lastly, with limited resources, we could not offer the participants free access to mammography to obtain data and compare two modalities

or provide pathological examinations for women diagnosed with BIRADS 3 lesions.

Conclusions

The initial results, such as recall rates and CDRs, suggest the potential of ultrasound for early breast cancer detection. The results may contribute to the data to consider ultrasound as a first-line modality for early breast cancer detection in under-resourced communities such as Central Vietnam. The proposed community-based integrated solution provides a scalable and sustainable framework for early breast cancer detection.

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Conflicts of interest

The authors certify that there is no conflict of interest with any financial organization regarding the material discussed in the manuscript.

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Authors' contributions

Ngoc H. Hoang and Huy Q. Nguyen have given substantial contributions to the conception; Ngoc H. Hoang, Hieu T. Hoang, Hien T. Ha, Linh T. Van, Huong T. Phan, Nhi T. Nguyen, and Tien C. Vo have contributed to acquisition, analysis and interpretation of the data. All authors have participated to drafting the manuscript. All authors read and approved the final version of the manuscript.

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